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bitter, like rivalry of the two fields of vision. That a chemically pure substance arouses different taste sensations (and those more purely gustatory than acid and salt) favors the doctrine that each taste sensation has its own specifically energized set of nerve fibres.

*Die Methode der Aequivalente angewandt zur Maassbestimmung der Feinheit des Raumsinnes.* Von Dr. W. CAMERER. Zeitschrift f. Biologie, 1886, pp. 509-559.

The chief object of this "method of equivalents" (first used by Weber) is to ascertain the relative sensibility of different parts of the sensory surface. Dr. Camerer contributes a very extensive though somewhat unsatisfactory series of observations on the "space sense" of the skin as tested by this method. For example, he places the compass points 4 lines apart (1 line=2.256 mm.) on the forehead, and then finds how far apart the points of a second compass must be to produce a sensation of equal aperture on the lips, and finds it 2.4 lines, *i. e.* the "aequalization ratio" of the forehead to the lips is  $\frac{4}{2.4} = 1.67$ .

The application of the line is always closely successive, and the variations caused by beginning with an aperture too wide and gradually narrowing, or reversing this proceeding; by applying the "constant" compass first or last; by varying the absolute distance between the compass points, are all worked out in detail. It is also evident that a constant as well as a variable error will come into play. The following table summarizes the results of the first portion of his experiments:

Constant Distances.	1st Series. Forehead to Lip.	2d Series. Forehead to Wrist.	4th Series. Palm to Forehead.	5th Series. Palm to Forehead.	Mean of 4th and 5th Series.	Constant Distances.	3d Series. Forehead to Finger Tip.
4 Lines.	1.668	1.0165	0.972	—	—	0.5	1.051
8 "	1.353	0.9763	1.043	0.982	1.012	1.0	1.055
12 "			1.048	0.996	1.022	1.5	1.044
16 "			1.037	0.989	1.013	2.0	1.033
20 "			1.016	0.985	1.000	2.5	1.028
24 "			1.032	1.003	1.017	3.0	1.025

Each ratio is based upon 240 observations, and the distances were always applied transversely. An important result is that the ratio is affected by the absolute size of the distance applied, the ratio approaching unity as the distance increases.

Many irregularities occur; while in the 4th series the forehead has a finer sensibility than the palm, in the 5th series this is reversed. It is also to be noticed that this method does not show nearly as great differences between the severable parts of the skin as Weber does with the method of "just observable differences."

The individual differences of the four observers who were tested were slight; the effect of practice was quite marked, as shown by a decrease of the aequalization ratio; and the average deviation (variable error) was about 8.5 per cent (in Series 1), it being considerably smaller in the larger distances than in the shorter ones.

A few other questions that were asked were these:

(1) If I have the aequalization ratio of the wrist to the forehead and also of the forehead to the lip, by multiplying the two will I get the same ratio for the sensibility of the wrist to the lip as I would by actual experiment? For the instance just noted this is found to hold, the calculated ratio being 1.4012 and the observed 1.3814. A similar comparison of the wrist, palm, and finger-tip, however, gave a discordant result.

(2) It was found that the sensibility near the median line of a limb or part of the body was very slightly superior to the lateral regions immediately next to it as well as to those farther removed.

(3) On the palm this method, that of the "right and wrong cases," and that of the "just observable difference," were applied to the relative sensibility of the longitudinal to the transverse axis, and all three agreed in making the transverse axis somewhat superior.

Dr. Camerer concludes that the reliability of the method is not clearly made out, and that the assumption of certain constants is necessary to account for the discrepancies to which it leads. An attempt is also made to bring the results into connection with the recent views of Goldscheider, but here again agreement is impossible. The facts must be accepted as such for the present, and their explanation be postponed until more is known of this ever widening field of research.

J. J.

*Untersuchungen über den Fühlraum der Hand.* Erste Mittheilung.  
Von Dr. J. LOEB. Arch. f. die Ges. Physiol., September, 1887.

With body fixed, all points touchable by the point of the index finger of a freely movable hand and arm are called, in imitation of Hering's optical nomenclature, the *tactile space* of the hand. The rectilinear distance between any two points in this hemispherical space is called the *tactile tract*. The *nuclear point* is, arbitrarily chosen, determined as the point in the median plane (between the tactile spaces of the two hands) where the index fingers meet when the upper arm is adducted and the elbows flexed at right angles. In the first series of experiments a horizontal thread was stretched through the nuclear point, and grasped at that point with thumb and finger of each hand. At a signal both hands moved symmetrically out with closed eyes and as nearly equal rate as possible till halt was called. The distance traversed by each hand was measured in experiments on about 30 persons. Each person was found to have a preferred hand which went always farther than the other, the difference being from one tenth to one half the entire tactile tract, and often with an apparent maximum at 150–200 mm. from the nuclear point, from which the experimenters always tried to keep the distance constantly equal for both hands. If one hand was moved passively, neither the sense nor the constancy of the result was affected, yet the tactile tract of the moved hand was very slightly increased. Knowledge of the constant error he was making on the part of the experimenter had only a temporary effect in correcting it. In hospital patients with unilateral defect the asymmetry was greatly increased. When both hands moved at the same time in the same direction the medial tract was always considerably greater than the lateral, but the over-estimation of the medial tract diminishes very rapidly when one hand passes over into the tactile space of the other. When one tract was marked off and felt, and another to be moved over judged to be equal to it, the reproduced